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ON INTEGRAL TRANSFORM METHOD IN THE STUDY OF IMPULSIVE FRACTIONAL DIFFRTENTIAL EQUATION AND ITS APPLICATION'S

By

Ms. Babar Shital Nandramji

(Research Student)

N E S Science College, Nanded

Email: shitalbabar9545@gmail.com Ph:7083788384

Under the Guidance of

Dr. Jadhav N.S.

Head Department of Mathematics

Madhavrao Patil Science College,

Palam Dist. Parbhani

Research Centre

Dept. Of Mathematics

N E S Science College, Nanded

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Abstract of Proposed work plan

In the present research work we shall study a class of impulsive fractional differential equation, theorems, properties and concepts related to integral transform methods and fractional differential equation. Also, we will try to find out new integral transform methods for the study impulsive fractional differential equation which will be new generalization on our research work. We prove the basic properties of new integral transform method including the rules for their compositions and the conditions for the equivalence of various definitions.

➢ Introduction:

Integral transforms are important to solve real problems appropriate choice of integral transforms helps to convert differential equations as well as integral equations into terms of an algebraic equation. The concept of integral transforms is originated from the Fourier integral formula. The importance of integral transforms is that they provide powerful operational method for solving initial and boundary value problems. The operational calculus of integral transform is used to solve the differential, fractional differential and integral equations arising in applied mathematics, mathematical physics and Engineering science

Dynamics of many evolutionary processes from various fields such as population dynamics, control theory, physics, biology, and medicine undergo abrupt changes at certain moments of time like earthquake, harvesting, shock and so forth. These permutations can well approximated as instantaneous change of states or impulses. These processes are modelled by impulsive differential equations. The fractional differential equation was extended to impulsive fractional differential equations since Agarwal and Benchora published the first paper in 2008 [23]. Since then many authors studied impulsive initial or boundary

value problems for fractional differential equations. Namely, on recent development in the theory of boundary value problem for impulsive fractional differential equation [14], on the initial value problems for the Caputo-Fabrizio impulsive fractional differential equations [21], study of impulsive fractional differential equation under Robin boundary conditions by topological degree method [3] etc.

Definition of Laplace transform

If f(t) is a function of time that is defined for all values of t >0, then Laplace transform of $f(t)$ denoted by $\mathscr{L}\{f(t)\}$ is defined as

$$\mathcal{L}\{f(t)\} = \int_0^\infty e^{-st} f(t)\, dt$$

Definition of Fourier transform

The Fourier transform of f(x), -∞ < x < ∞, denoted by $\bar{f}(\lambda)$ where λ ϵ N is given

$$\mathbf{F\{f(x)\} = \bar{f}(\lambda) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} e^{i\lambda x} f(x)\, dx}$$

Definition of the Mellin transforms of fractional derivative:

The Mellin integral transform F(s) of a function f (t). which is defined in the interval is (0, ∞)

$$\mathbf{F(s) = M\{f(t); s\} = \int_0^\infty f(t) t^{s-1}\, dt}$$

The main aim of the paper is to present a new integral transform method for handling the solution of impulsive fractional differential equation and application. Also, we will try to find out new integral transform method for the study of impulsive fractional differential equation which will be new generalization on our research work.

➢ Review of Literature and Development on the Subject
(Previous work done in the relevant area)

Fractional Calculus is one of the most important topics that occupy researchers and scientists in various mathematical, engineering, physical and other disciplines. In recent years, there have been many results obtained on the existence and uniqueness of solutions of initial value problems or boundary value problems for nonlinear fractional differential equations.

The integral transforms have applications in various fields of science and engineering such as fluid mechanics, viscoelasticity, chemistry, physics and finance. Typically, Fourier [15], Laplace [9], Sumudu [16], and Elzaki [19] transforms are the convenient mathematical tools for solving differential equations. A new integral transform is defined for functions of exponential order. This transform has deeper connection with the Laplace transform.

Renato M Cotta Proved that the integral transform method is reviewed as a benchmark tool in computational heat and fluid flow, with special emphasis on nonlinear problems [24], Xiao-Jun Yang introduced a new integral transform method for solving steady heat transfer problem [26], Bachir Nour Kharrat introduced a new integral transform:Kharrat-Toma transform and it's properties [5], Lokenath Debnath, Dambaru Bhatta integral transforms and their applications [18], Prem kumar, Sania Qureshi Laplace-Carson integral transform for exact solutions of non-integer order initial value problems with Caputo Operator [22] etc.

➢ Objective of Research Study:

1. To study the basic integral transforms like Laplace and Fourier etc
2. To study impulsive fractional differential equation and its types
3. To study the properties of integral transform and that of impulsive fractional differential equation
4. To study some recent integral transform like Sumudu, Elzaki etc. and their properties
5. Try to introduce new integral transform and its properties
6. To find the solution of impulsive fractional differential equation using this new integral transform method.

➢ Importance of Study/Society Application:

1) International status:

many mathematicians generalised the result of impulsive fractional differential equation, such as global Mittag-Leffler stability and synchronisation of impulsive fractional order neural networks with time varying delays by Ivanka Stamova [10], M Feckan JR Wang, Y Zhou on the new concept of solutions and existence results for impulsive fractional evolution equations [20], Arshad Ali, Kamal Shah, Thabet Abdeliawad, Ibrahim Mahariq, Mostafa Mathematical analysis of nonlinear integral boundary value problem of proportional delay implicit fractional differential equations with impulsive conditions[4], J V C Sousa, K D Kucche worked on stability of ψ-Hilfer impulsive fractional differential equation[11].

2) National Status:

Indian mathematicians S Rashid, K T Kubra, S Ullah work on fractional spatial diffusion of biological population model via a new integral transform in the setting of power and Mittag-Leffler non-singular kernel [25], Alka Chaddha, Dwijendra N Pandey work on approximations of solutions for impulsive fractional differential equation with a deviated argument [2], Fractional order derivatives and integrals: introductory overview and recent developments by Hari Mohan Srivastava [17], Existence of the mild solutions for impulsive fractional equations with infinite delay by Jaydev Dabas, Archana Chauhan, Mukesh Kumar [13].

➢ Methodology and Stages in Research Work:

- ❖ In the first stage of my research work, I will try to build up the necessary background to understand the area of my research work and for this purpose I will read the useful research textbooks.
- ❖ Survey of research papers to collect the literature related to my research problem.
- ❖ Generalisation of new theorems which will be new contribution in research.
- ❖ Fourth stage will be new results and conclusion. Fifth stage Bibliography and Reference book.

➢ Year wise Plan of Work and Target to be Achieved:

- **First Year:** From different research centres, libraries and Internet we will study the basic literature related to the research problems. Researcher will attend and present some papers in some journals and conferences. Also, to complete course work and to submit annual progress report.
- **Second Year:** Attending the conference workshop and seminars in relevant topic and collect research papers to study for further research work. Also analysing recent researches related to topic for directing our research.
- **Third Year:** In this stage we will study some integral transform theorems and its generalised form. Then we will use this generalised result in the study of impulsive fractional differential equation to find solution.

  Also, to publish research paper in reputed journals and to find application of integral transform method in the impulsive differential equation and plan to submit the thesis to university.

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Signature of Research Scholar **Signature of Research Supervisor**